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19. ABSTRACT (Continue on reverse if necessary and identify by block number)  This is the Airframe Condition Evaluation and Aircraft Analytical Corrosion Evaluation (ACE/AACE) inspection and analysis handbook which was prepared to provide U.S. Army Aviation Systems Command (AVSCOM) managers, commanders of operational units, engineers, team members, and others with a practical reference document of criteria, guidelines, and other information applicable to the ACE/AACE program. The handbook is in three parts: Part I-Management, Part II-Engineering, and Part III-Profiling.					
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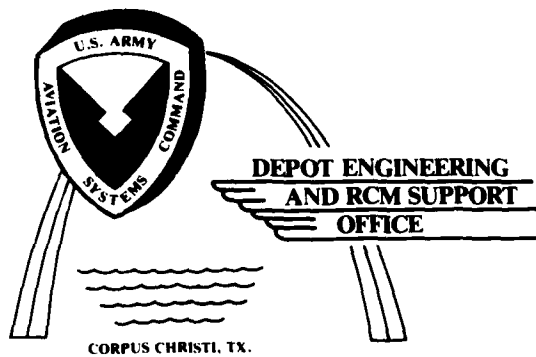
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# ACE/AACE INSPECTION AND ANALYSIS HANDBOOK

## PART II - ENGINEERING



Prepared as a Special Task under the auspices of the  
Nondestructive Testing Information Analysis Center  
for

**U.S. ARMY AVIATION SYSTEMS COMMAND**

**APRIL 1985**

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## 1.0 INTRODUCTION TO PART II - ENGINEERING

The Airframe Condition Evaluation (ACE)/Aircraft Analytical Corrosion Evaluation (AACE) program is implemented through detailed engineering planning and analysis. The methodology used is a sequential process consisting of the following: indicator selection, condition code determination, indicator ranking, indicator weighting, aircraft profiling, profile index determination, threshold determination, and candidate aircraft identification. Application of this methodology performs the on-condition maintenance action required in AVSCOM Regulation 750-7 for first line/mission essential aircraft in order to maintain an optimum readiness posture and aircraft flight safety level. This second part of the handbook provides specific guidelines for using the ACE/AACE methodology, selecting and revising indicators, analyzing field profiling data, and determining the optimum engineering threshold.

This part is designed to be compatible with the two other parts of this handbook. Part I delineates the various interrelated management aspects of reliability-centered maintenance, on-condition maintenance, and ACE/AACE. Part III delineates the various aspects of implementing the ACE/AACE aircraft profiling examination.



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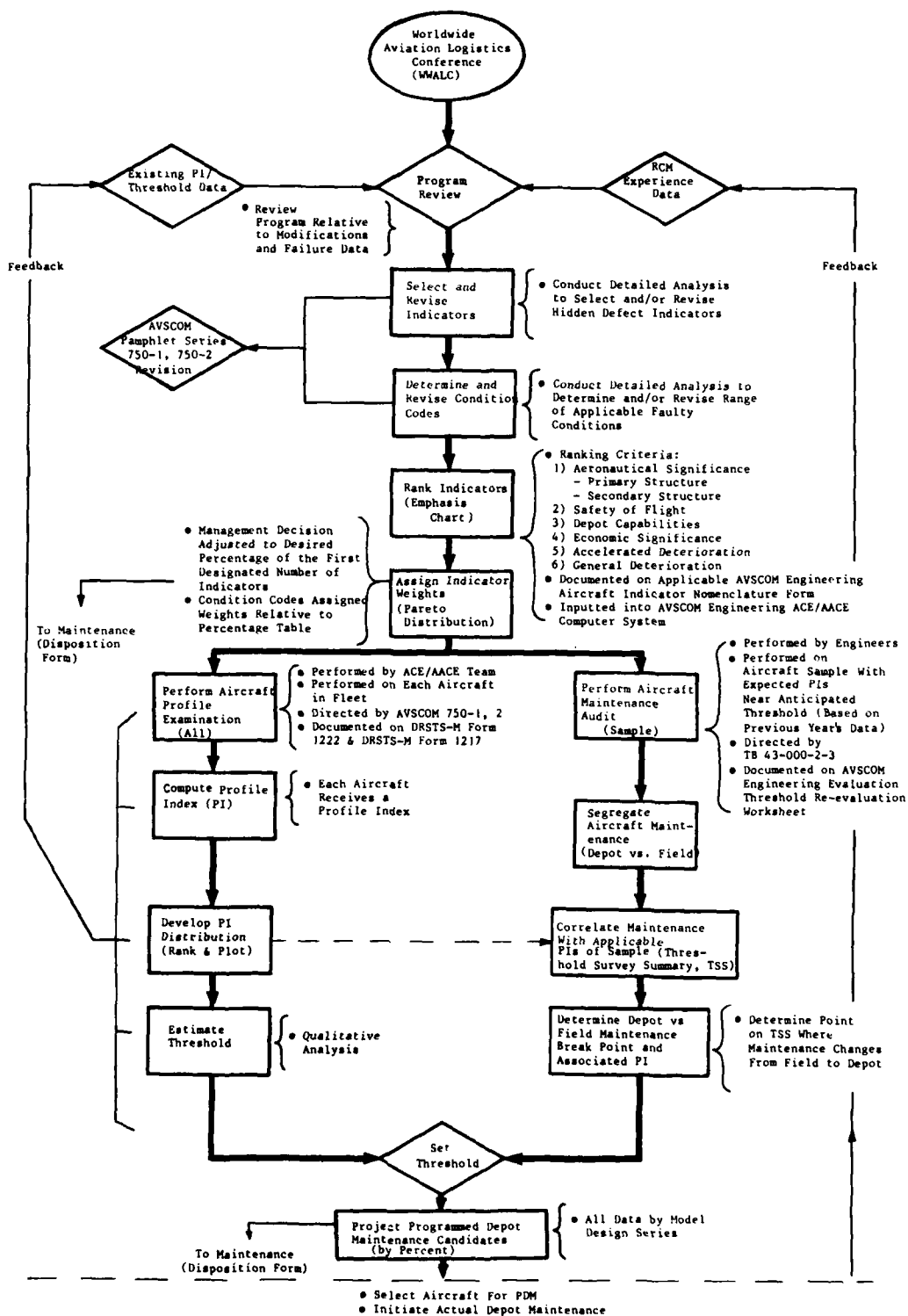


Figure 2-1 ACE/AACE Program Cycle

## 2.0 ACE/AACE METHODOLOGY

Airframe Condition Evaluation (ACE) is an airframe structure evaluation with emphasis on structural members that are not replaceable at maintenance levels below depot. Aircraft Analytical Corrosion Evaluation (AACE) is a special corrosion inspection pertaining principally to fuselage structural members that are replaceable at the depot and also to dynamic components and component structure (for example, tailboom, vertical fin, and horizontal stabilizer). ACE and AACE are performed in conjunction with each other by a trained ACE/AACE team. The difference between the two is that ACE is considered an evaluation, whereby airframe condition is based on the relative condition of specified indicators, while AACE is considered an inspection, whereby practically all visible surfaces of the aircraft are examined for corrosion relative to predefined condition levels. AACE also addresses dynamic components whereas ACE does not.

ACE/AACE uses a selective list of indicators of structural deterioration for a specific aircraft type and assigns weights, based on criticality, to each indicator. Using this list of indicators, the ACE/AACE team annually profiles every aircraft in the Army fleet using applicable AVSCOM 750-1 and 750-2 Pamphlets. The indicators are noted by their worst condition code (or varying degree of degradation) on worksheets. Completed worksheets are then summarized and sent daily to a main data collection center where the summed weights of the profile are determined to develop a profile index (PI) for each aircraft. The PI is a numerical representation of the condition of an aircraft. Aircraft with a PI exceeding a specified threshold are identified as candidates for depot level maintenance. This process ensures that the aircraft most in need of depot maintenance are removed from the field and sent to the depot.

ACE/AACE is performed through the course of a yearly cycle illustrated in Figure 2-1. The process begins with the Worldwide Aviation Logistics Conference (WWALC) and ends with the selection of aircraft maintenance candidates (and the subsequent initiation of phased depot maintenance) during the following year's WWALC. During the course of the year, the Depot Engineering and RCM Support Office reviews the ACE/AACE program for improvements using readily available data sources to maintain an optimum level of program effectiveness. This includes updating the AVSCOM Pamphlet series 750-1 and 750-2, as necessary.

From Figure 2-1 it is seen that application of the ACE/AACE methodology involves the following eight steps:

- STEP 1: Select Indicators
- STEP 2: Determine Condition Codes
- STEP 3: Rank Indicators
- STEP 4: Assign Weights to Indicators
- STEP 5: Examine Aircraft (ACE/AACE Team)
- STEP 6: Compute Profile Index for Each Aircraft
- STEP 7a: Estimate Threshold by Qualitative Analysis
- STEP 7b: Set Threshold by Aircraft Maintenance Audit
- STEP 8: Identify Candidate Aircraft

Each of these steps is an integral part of ACE/AACE engineering planning and analysis. Application of this methodology and the resulting depot maintenance ensures that aircraft structures remain in good condition and, consequently, are able to fully support mission requirements.

#### **Step One: Select Indicators**

Indicators are selected by experienced ACE/AACE engineers who conduct a thorough aircraft analysis to determine the airframe symptoms of distress (i.e., indicators) that are appropriate for profiling. This analysis also considers the impact on structural integrity of not repairing an identified section of airframe deterioration. The number of indicators for a specific aircraft type ranges from 40 to 50. These indicators are annually reviewed and revised, as needed, to reflect current experience and changing depot capability.

The selection of suitable indicators takes into account the following four criteria:

- (1) Aeronautical significance,
- (2) Depot capability,
- (3) Accelerated deterioration, and
- (4) General deterioration.

The indicator selection process based on the above criteria is described in Section 3.0.

#### **Step Two: Determine Condition Codes**

A list of condition codes is developed for each indicator to denote its varying degree of degradation, such as dented, delaminated, and corroded, or good, fair,

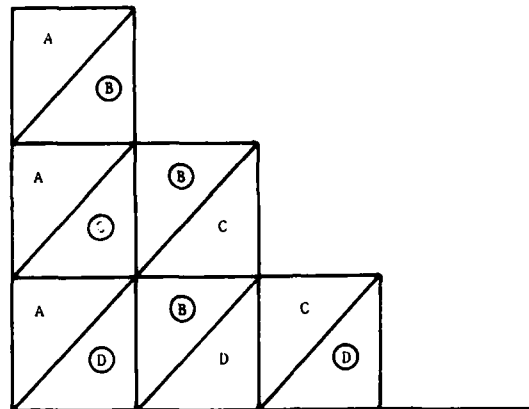
and poor. The number of condition codes for each indicator varies from 1 to 9. Condition codes are also reviewed and revised, along with the indicators, to reflect current experience factors. The selection and specification of condition codes is done in conjunction with the indicator selection process discussed in Section 3.0.

### **Step Three: Rank Indicators and Condition Codes**

The ranking of indicators is performed by listing each indicator and then comparing it against each of the other indicators involved. This ranking procedure is carried out using an "emphasis chart" (Figure 2-2). The comparison of each indicator against each other indicator is based upon the following criteria:

- Could one of the conditions indicated itself be hazardous or could it progress to become hazardous?
- Could one of the indicators be the cause of customer rejection?
- Which of the indicators better shows accelerated airframe deterioration or consumption of components?
- Which of the indicators better shows fair wear and tear?
- The relative cost of item replacement.

In Figure 2-2, using these criteria, indicator A is compared against indicator B; then, indicator A is compared against indicator C; etc. In each case, the more critical indicator is circled and, when all indicators have been compared, the number of times an indicator has been circled is counted and noted. These numbers reflect the rank or importance of each item in relation to the other indicators with respect to the criteria.



<u>Indicators</u>		<u>Ranking</u>	
A.	Corrosion Protection	1.	Main Lift Beam (Circled 3 times)
B.	Main Lift Beam	2.	Upper Aft Bulkhead (Circled 2 times)
C.	Nose Fuse, Skin	3.	Nose Fuse, Skin (Circled 1 time)
D.	Upper Aft Bulkhead	4.	Corrosion Protection (Not Circled)

Figure 2-2 Emphasis Chart

#### Step Four: Assign Weights to Indicators

Indicator weights are assigned utilizing Pareto's Principle of Maldistribution. Pareto's concept is that a small portion of the indicators will lead to a large portion of aircraft problems. Figure 2-3 illustrates the Pareto curve and the weight assignment process.

Pareto's distribution is expressed mathematically as a hyperbolic curve of the form  $xy = A$  where  $x$  is indicator rank,  $y$  is  $A/(\text{indicator rank})$ , and  $A$  determines the shape of the curve and how significant the lower ranking indicators are. By proper choice of the constant  $A$ , weighting of the indicators can be adjusted to achieve the balance desired. This choice of  $A$  is a management decision and it is usually related to the desired weight percentage of the first designated number of indicators. The weight distribution for the indicators is determined by the ratio of the area under the curve in the respective indicator interval to the total area under the curve with truncation at  $x = \text{number of indicators}$  and  $y = \text{number of indicators}$ . The sum of all indicator weights is normalized to 1000. The following equation is used to determine the indicator weights:

$$\text{Indicator Weight} = \frac{\text{indicator interval area}}{\text{total truncated area}} \times 1000$$

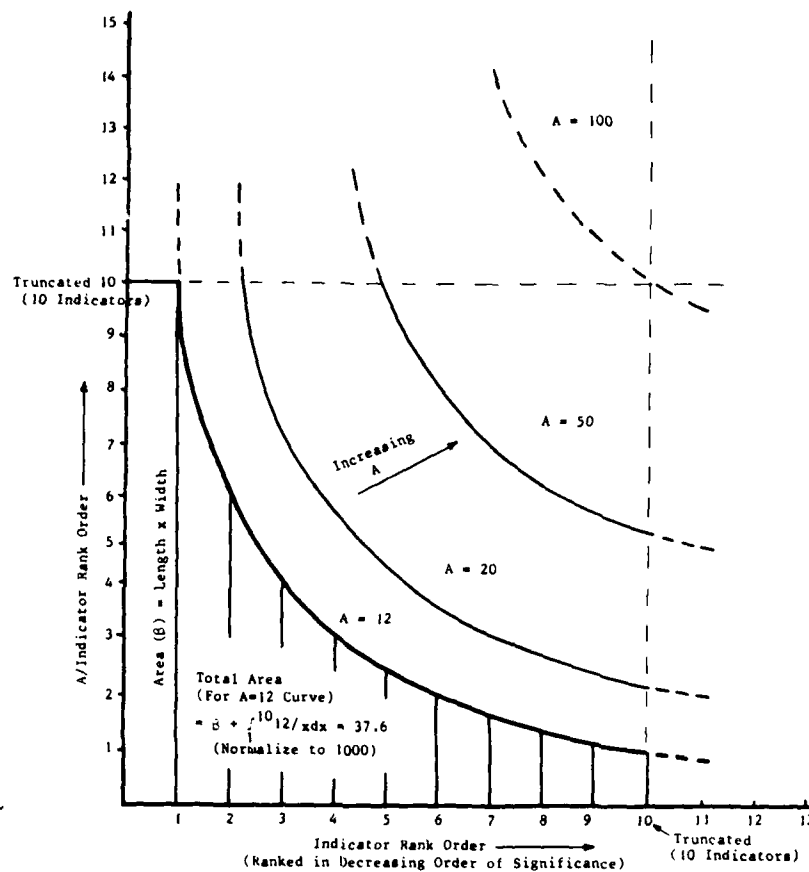


Figure 2-3 Pareto Distribution Curve

From the example illustrated in Figure 2-3 with 10 total indicators, a shape factor, A, of 12, and normalization to 1000:

$$W_1 = \text{area } (\beta) \text{ of indicator with rank order } 1 = 10 \times 1 = 266$$

$$W_2 = \text{area under curve of indicator with rank order 2} \approx \int_1^2 12/x \, dx = 221$$

$$W_3 = \text{area under curve of indicator with rank order 3} = \int_2^3 12/x \, dx = 129$$

and so on.

The total weight distribution for this example is:

Indicator (Rank Order)	Weight, $W_i$
1	266
2	221
3	129
4	92
5	71
6	58
7	49
8	43
9	38
10	34

Figure 2-3 also shows that, as the shape factor  $A$  increases, the weight distribution becomes more even. When  $A = (\text{number of indicators})^2$ , all indicators have the same weight.

The weights established by the Pareto process represents the maximum possible values. If, during examination by the profiling team, an indicator shows the worse condition, then 100% of the indicator weight is applied to PI determination. If the aircraft indicator shows a nonfaulty condition, then 0% of the weight is applied to PI determination. The determination of condition code weights is discussed in Section 4.0.

#### **Step Five: Examine Aircraft (ACE/AACE Team)**

Once the indicators have been selected and weights assigned, then each aircraft within the fleet is profiled in accordance with the AVSCOM Pamphlet series 750-1 and 750-2. This profile assigns the applicable condition codes, recording them on ACE/AACE worksheets for subsequent PI computation. This aircraft profiling is performed by a carefully selected, well trained ACE/AACE team. The team members are generally provided by an outside contractor, but trained by AVSCOM ACE/AACE engineers. A training course takes place once a year at the Corpus Christi Army Depot (CCAD) shortly before the team is sent throughout the world to examine the Army aircraft fleet. The current number of trainees is 26; 20 contractor personnel comprise the team and 6 Army personnel remain at CCAD as "in-house" reserve.

The engineering objective of training is to develop a team capable of providing uniform and consistent profiling data. This minimizes profiling discrepancies while achieving an efficient, consistent, and cost-effective profile. The data compiled by the team create a data base whereby optimum management decisions and actions can be derived through engineering analysis. Part III of this handbook describes the ACE/AACE aircraft profiling process and provides guidelines to aid in its conduct.

#### **Step Six: Compute Profile Index for Each Aircraft**

The ACE/AACE engineers sum the weights of the indicator condition codes selected for each aircraft to give the profile index (PI) for that aircraft. This PI then is a numerical representation of the condition of the aircraft. Guidelines for computation of PI are given in Section 4.0.

#### **Step Seven: (A) Estimate Threshold by Qualitative Analysis, and (B) Set Threshold by Aircraft Maintenance Audit**

To be selected for programmed depot maintenance, an aircraft must surpass a specified threshold PI. Various criteria can be used to establish a threshold, such as safety, mission capability, availability, reliability, economic, and depot capabilities. A threshold can be established such that any desired percentage of the fleet is returned for depot repair. It should be established based on past depot maintenance and field experience data. The threshold is a powerful decision point since it dictates the condition of the entire fleet as well as the amount of money allocated for aircraft depot repair. Section 4.0 further describes threshold establishment.

The engineering threshold determined is then scrutinized by appropriate management personnel and, based on budget limitations, a management threshold PI is established which dictates the aircraft to be actually inducted into the depot. This threshold PI difference between engineering (necessary overhaul) and management (approved overhaul) develops a readiness gap which identifies the aircraft between the two thresholds as being potentially not mission available. Figure 2-4 illustrates the readiness gap on a profile index distribution.

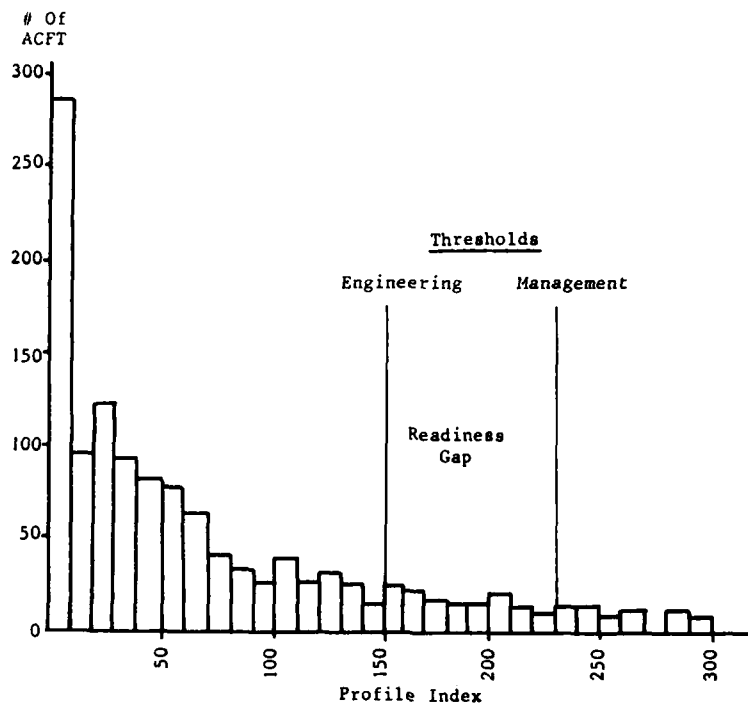


Figure 2-4 Profile Index Distribution and Thresholds

#### Step Eight: Identify Candidate Aircraft

Aircraft with a PI exceeding the engineering threshold are identified as candidates for depot level maintenance. The actual selection of aircraft for depot repair is made by management (Part I of this handbook).

#### Interrelationship of ACE/AACE Program Elements

ACE/AACE program elements are interrelated. Changes in one must be carefully considered to determine if a corresponding change is necessary in another. For example, if new indicators are developed, then the current indicator ranking must be reevaluated to correctly reflect the additions. This dictates that the Pareto curve be replotted and the weights recalculated. This further dictates that the applicable PI threshold be reevaluated. Likewise, the addition of condition codes to indicators may warrant threshold reevaluation.

### 3.0 INDICATOR SELECTION

Indicators are used to provide an accurate projection of airframe condition with minimum disassembly. Aircraft condition indicators are selected through disciplined engineering analysis of aircraft design and historical repair and failure data. This includes interacting with depot line personnel to capture the wealth of information that is derived from actual "hands on" aircraft maintenance experience.

The selection is performed using a five step process based on a set of criteria designed to provide optimum cost effectiveness and aircraft availability. Figure 3-1 illustrates the indicator selection process used by ACE/AACE engineers. Following this process, a set of indicators for a specific type of aircraft is selected and compiled for an airframe in a format suitable for ACE/AACE aircraft profiling. This process is also used to annually review and revise, as needed, the AVSCOM 750-1 and 750-2 Pamphlet series to reflect changes in indicators. Along with updating the current pamphlet series, new pamphlets are developed reflecting indicators selected for aircraft new to the ACE/AACE program.

#### Selection Criteria

The following criteria are used to guide the selection of indicators:

1. Aeronautical Importance - The criticality of the deficiency to aircraft availability. This includes assessing the impact of the deficiency on:
  - a. Safety of Flight
  - b. Mission Essentiality
  - c. Interchangeability
2. Depot Capability - The need and economic impact of performing maintenance at the depot. This includes:
  - a. Man hours and material
  - b. Tools
  - c. Facilities
  - d. Procedures and processes
  - e. Expertise
  - f. Maintenance Allocation Chart (MAC)
  - g. Experience Data

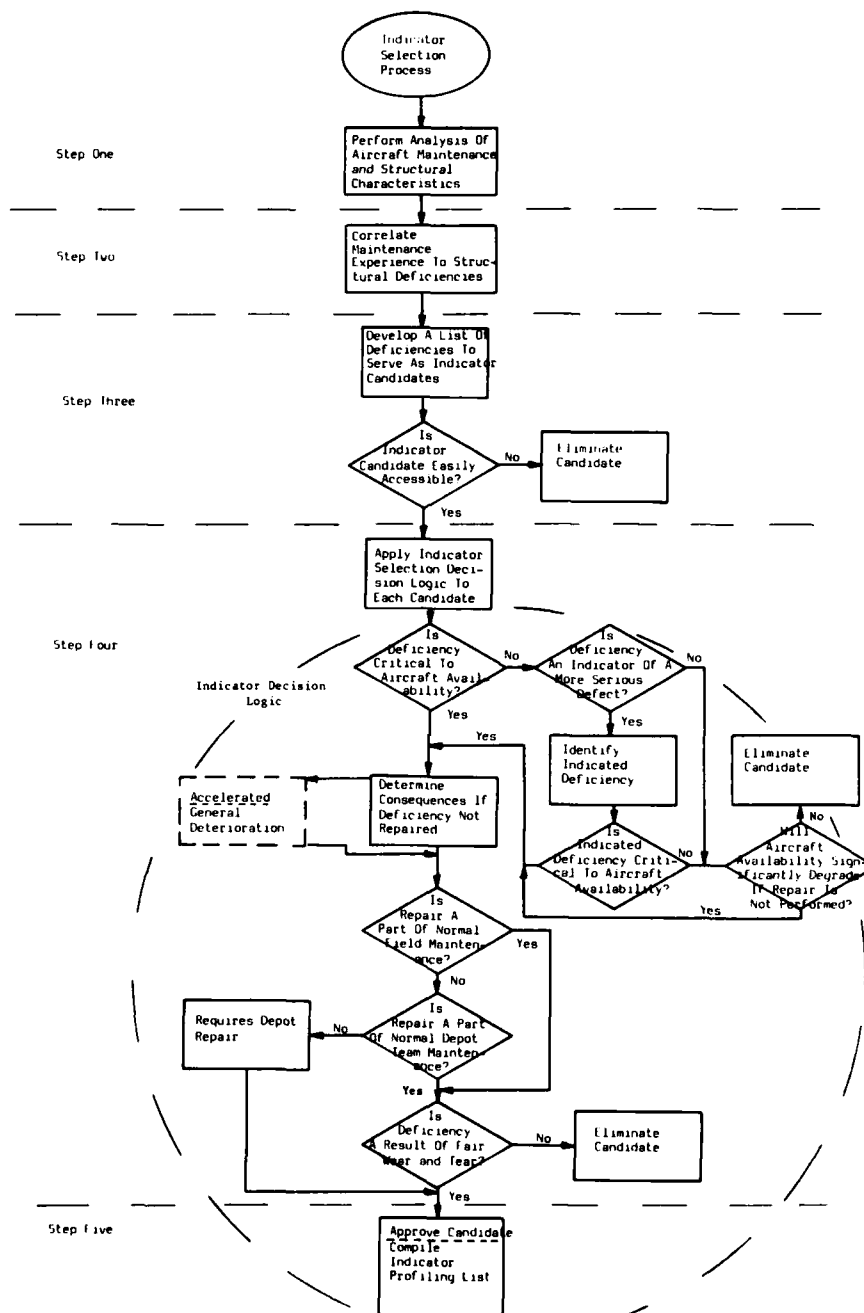


Figure 3-1 Overall Indicator Selection Process

3. Accelerated Deterioration - The increase in deterioration if a needed repair is not performed.
4. General Deterioration - The expected deterioration if aircraft remains in the field until next profile.

#### Selection Process

The selection of indicators is a systematic process consisting of five steps:

*STEP ONE: Aircraft Familiarization* - Perform a detailed and thorough analysis of significant aircraft characteristics pertaining to maintenance and structural design. Compile and document information relevant to the selection criteria (as defined previously) and the specific areas delineated below for use in Steps Two, Three, and Four.

*Some of the significant maintenance items that should be reviewed include:*

1. Interchangeable aircraft points - The basic attach points providing for quick and easy component removal/replacement.
2. Tool controlled aircraft structure - The structural components requiring specialized equipment for inspection, alignment, etc. Repair for these components may require depot attention as the only applicable maintenance level.
3. Aircraft major assembly tools - The specialized equipment needed to perform assembly and disassembly of the basic aircraft. For example, jigs and fixtures used to position parts during their formation of a sheet metal assembly.
4. Aircraft portable alignment tools - Any applicable portable equipment which are used to control parts locations while performing repair by depot teams sent to field units.
5. Aircraft assembly procedures - The general aircraft assembly procedures including any specialized equipment needed to perform such action.

6. Maintenance man hours needed to repair and replace items - The estimation of man hours and costs needed to perform basic repair tasks which frequently arise. The evaluation of costs is done relative to the depot, AVIM, and AVUM.
7. Structural component replacement procedures - The examination of various modular design points (as identified in point one (1) above) and the prescribed action taken by each maintenance level. For example, a component removed from an aircraft at AVUM may need to be sent to AVIM; if AVIM cannot perform needed repair on the component, then the component is sent to the depot for repair or rebuild.
8. Structural component repair procedures - The examination of the various maintenance levels capability to perform a specific repair procedure taking into account skills available, man hours needed, costs, etc.
9. Aircraft Maintenance Allocation Chart (MAC) - The use of MACs to identify maintenance assigned functions for AVUM, AVIM, and the depot based on skills available, time required, and tools and test equipment required and/or available.
10. Maintenance tasks for the three levels of maintenance - The maintenance tasks applicable to each maintenance level are identified in the appropriate technical manual (TM) which is directed towards a specific aircraft system/equipment. A TM normally contains a MAC which delineates the various repair task that can be performed on said system/equipment and the applicable maintenance level.
11. Depot level tools
12. Depot level facilities
13. Depot level procedures and processes
14. Depot level expertise

The identification of various depot capabilities (for points 11-14 above) and specific repair tasks which must be performed at the depot or by a depot team sent to the field unit.

*Some of the significant structural and aeronautical items that should be reviewed include:*

1. Primary structure and failures - The identification of structure and deficiencies that directly affect alignment of major dynamic components and receive the primary structural loads.
2. Secondary structure and failures - The identification of structure and deficiencies that do not directly affect the alignment of major dynamic components, and yet support the primary structure.
3. Electrical and avionics problems - The evaluation of historically frequent deficiencies.
4. Armament problems - The evaluation of historically frequent deficiencies.
5. Flight envelope - The various flight phases through which the aircraft passes during mission conduct. Phases are start-up and taxi, take-off, ascent, cruise-out, mission, cruise-in, descend, land and taxi, and shut-down for fixed wing aircraft and start-up, hover-out, take-off, climb-out and cruise, mission, cruise-in and descend, landing approach, hover-in, and shut-down for rotary wing aircraft.
6. Corrosion - The various corrosion characteristics plaguing a specific aircraft, including types, direct impact, and geographical influence.
7. Flight hours - The flight time between maintenance actions.
8. Type of design - The various design parameters such as modularity, system size, composite bonding, etc.

The origin and mode of all aeronautical failures should be reviewed in detail. The pie charts presented in Figures 3-2 and 3-3 identify the various aircraft components historically contributing to flight safety incidents and direct maintenance costs. For a specific aircraft, experience data should be examined to highlight various aeronautical failure modes and origin.

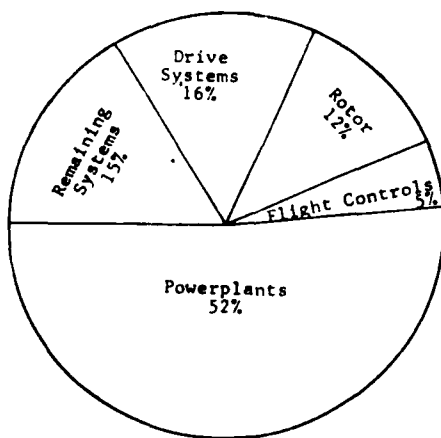


Figure 3-2 Components Contributing to Flight Safety Incidents

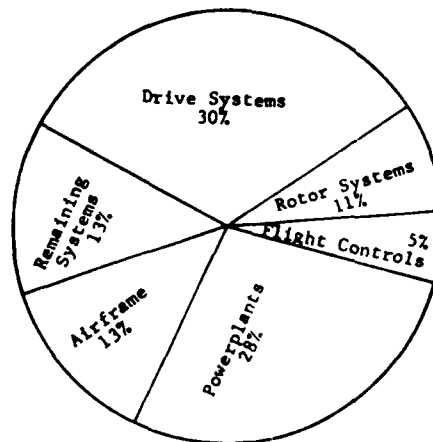


Figure 3-3 Components Contributing to Direct Maintenance Costs

**STEP TWO: Maintenance Experience/Structural Deficiency Correlation** - Correlate maintenance experience to aircraft locations which may display a deficiency indicative of a potentially more serious hidden structural deficiency. Correlations are made based on the information compiled in Step One.

**STEP THREE: Indicator Candidate List Development** - Develop a list of indicator candidates based on the aircraft maintenance characteristic/correlation data from Steps One and Two. Review each candidate to determine if they are easily accessible and discernible by a trained ACE/AACE profiler. Those candidates that are not easily accessible and discernible are removed from the list.

**STEP FOUR: Indicator Selection Decision Logic Application** - Apply the selection decision logic delineated in Figure 3-1 to systematically approve or disapprove each indicator candidate. The information compiled during Steps One and Two are used to help answer the decision logic questions.

**STEP FIVE: Aircraft Indicator List Compilation** - Approve indicator candidates and compile indicator profiling list.

When selecting new indicators, similar aircraft designs should be addressed, as appropriate, to assist in identifying symptoms of airframe distress. This reduces analysis time and promotes uniform profiling results. Table 3-1 provides examples of various aircraft indicators and what the indicators actually indicate if a deficiency exists at the location. Prudent indicator selection will follow if the process described previously and delineated in Figure 3-1 is systematically followed using accurate and well documented engineering data.

All information generated during the selection process should be well documented identifying each indicator, the deficiencies to be observed, and what the deficiencies are indicating, i.e., what structural defects may exist elsewhere in the aircraft based on the immediate observable deficiencies. Also, the general characteristic nature of an indicator should be documented to assist in the assignment of condition codes. Condition codes are used to identify the condition of the indicators being evaluated. These codes identify "what can go wrong" and/or "how bad it is" in reference to a specific indicator. This documentation is vital to maintaining a consistent and accurate engineering planning and analysis effort.

Table 3-1 Examples of Indicators and What They Indicate

Aircraft	Indicator	Indication
UH-1	Aft Fuselage Skin, Exhibiting Buckling	<ul style="list-style-type: none"> <li>• Misalignment of the Longerons that Support the Tailboom</li> <li>• High Local Stresses</li> </ul>
	Cargo Door Tracks, Exhibiting Cracking and Excessive Wear	<ul style="list-style-type: none"> <li>• Excessive Vibration</li> <li>• High Landing Loads</li> <li>• Extreme Helicopter Usage</li> </ul>
	Pylon Assembly, Exhibiting Cracking, Buckling, and Looseness	<ul style="list-style-type: none"> <li>• Repetitive Landing at or Near the Design Limits</li> <li>• The Shaking Response from the Incoming Twice Per Rev Frequency</li> </ul>
OH-58	Transmission Support, Exhibiting Cracking and Looseness	<ul style="list-style-type: none"> <li>• Excessively Hard Landing</li> <li>• Excessive Rotor Vibration</li> </ul>
	Center Post Assy, Exhibiting Buckling, Cracking, and Looseness	<ul style="list-style-type: none"> <li>• Hard Landing</li> <li>• Repeated Landings Exceeding Design Loads Over a Prolonged Period of Time</li> </ul>
	Door Posts, Exhibiting Looseness and Cracking	<ul style="list-style-type: none"> <li>• Degree of Helicopter Service</li> <li>• Possible Twisting of Cabin Structure</li> </ul>
	Fuel Cell Exterior Honeycomb, Exhibiting Delamination Deterioration, Puncture, Corrosion and Dents	<ul style="list-style-type: none"> <li>• Passenger Seat Belts Banging and Cutting into the Honeycomb during Flight with Doors Removed</li> </ul>
	Tailcone Structure, Exterior, Exhibiting Looseness, Buckling, and Cracking	<ul style="list-style-type: none"> <li>• Hard Landing</li> <li>• Repetitive Loads in Excess of Design Parameters</li> </ul>
	Tailboom Skin 1st and 2nd Bays, Exhibiting Looseness, Buckling, and Cracking	<ul style="list-style-type: none"> <li>• Possible Hard Landing</li> </ul>
U-21	Nose Landing Gear Attach Fittings Exhibiting Looseness, Cracking, Corrosion, and Scratchings	<ul style="list-style-type: none"> <li>• Uneven Loading</li> </ul>
	Formers F.S. 57.5 and F.S. 84.0, Exhibiting Corrosion, Buckling, Looseness, and Cracking	<ul style="list-style-type: none"> <li>• Hard Landing</li> <li>• High Landing Loads</li> </ul>
	Left and Right Main Spar F.S. 160 Exhibiting Corrosion, Buckling, Looseness, and Cracking	<ul style="list-style-type: none"> <li>• Excessive Reactive Loads from the Main Landing Gear</li> <li>• High Landing Loads</li> <li>• Excessive Engine Vibration</li> </ul>
	Engine Firewall, Exhibiting Corrosion, Buckling, Looseness, and Cracking	<ul style="list-style-type: none"> <li>• Excessive Engine Vibration</li> </ul>
OH-6	Cabin Doors, Exhibiting Cracking and Misalignment	<ul style="list-style-type: none"> <li>• Hard Landing</li> </ul>
	Battery Compartment, Exhibiting Corrosion and Looseness	<ul style="list-style-type: none"> <li>• Battery Spillage</li> <li>• Poor Servicing Techniques</li> </ul>
CH-47	The Nose Section, Exhibiting Looseness, Cracking, Improper Hardware, and Buckling	<ul style="list-style-type: none"> <li>• Severe Structural Vibration</li> </ul>
	Center Section, Exhibiting Looseness, Cracking, Buckling and Improper Hardware	<ul style="list-style-type: none"> <li>• Excessive In-flight Loads</li> <li>• Hard Landing</li> </ul>
	Upper Pylon, Exhibiting Looseness, Cracking, Buckling, and Improper Hardware	<ul style="list-style-type: none"> <li>• Excessive Power Train Loading</li> <li>• Hard Landing</li> <li>• Abnormal Flight Loads</li> <li>• High Landing Loads</li> </ul>
	Upper Tunnel, Exhibiting Looseness and Cracking	<ul style="list-style-type: none"> <li>• Out of Balance Drive Shafting</li> </ul>
	Cockpit Transparencies, Exhibiting Various Degrees of Deterioration	<ul style="list-style-type: none"> <li>• Severity of Helicopter Service</li> </ul>

#### 4.0 DETERMINATION OF PROFILING INDEX AND THRESHOLD

The selection of an indicator condition code by the ACE/AACE team dictates the numerical value for that indicator used in formulating the aircraft profile index (PI). The proportion of the indicator weight used in formulating the PI depends on the total number of faulty condition codes for that indicator and the order of severity of the condition. Table 4-1 presents the weight distribution (by percent) associated with condition codes.

Table 4-1 Condition Code Weight Distribution

No. of Faulty Codes	% of Total Indicator Weight for Codes (listed worst to best)					
	First Code	Second Code	Third Code	Fourth Code	Fifth Code	Sixth Code
6	100	50	20	15	10	5
5	100	50	25	15	10	0
4	100	50	30	20	0	0
3	100	60	40	0	0	0
2	100	60	0	0	0	0
1	100	0	0	0	0	0

EXAMPLE: OH-6 Indication - Paint Condition Has Weight of 79	
<u>Condition Code</u>	<u>Numerical Value Used in Formulating PI</u>
C - Deteriorated	79 (100% of 79)
K - Poor	47 ( 60% of 79)
L - Fair	32 ( 40% of 79)
M - Good	0 ( 0% of 79)

After the numerical values are set for each indicator by condition code (for a specific aircraft), these values are summed over the entire aircraft to obtain a profile index (PI) value for the aircraft. The PI provides a quantification or numerical ranking of the condition of each aircraft as compared to other aircraft and thereby provides a means to rank the fleet in terms of need of programmed depot maintenance (PDM). For example, an aircraft with a PI of 100 is in greater need of

depot repair than one with a PI of 50. It should be recognized that an aircraft with only one major faulty indicator may outrank an aircraft with several faulty indicators because of the Pareto principle.

With the aircraft ranked by their need for repair, criteria for determining which aircraft are depot candidates are developed. The establishment of a threshold for the induction of aircraft into depot maintenance is a key part of the ACE/AACE program since it determines the operational acceptance level for the airframes of the active fleet. A threshold is expressed in terms of PI and, once an aircraft's PI reaches or exceeds the threshold, it becomes a candidate for depot repair.

In determining the engineering threshold PI, a general trend cut-off point becomes evident through analysis of the aircraft PI distribution. To pinpoint the exact threshold PI, an experienced ACE/AACE engineering team conducts an audit of sample aircraft with PIs expected to be near the anticipated threshold PI (based on previous year's data). These engineers conduct a thorough and detailed examination of the aircraft to provide an approximate overhaul/repair cost of the aircraft and to also determine if needed maintenance must be performed at the depot or if it can be performed at the field unit with or without assistance from a depot team. The worksheets used to perform this examination are given in Appendix C of this handbook part. Once the sample aircraft are segregated by maintenance need, i.e., depot or field, a Threshold Survey Summary (TSS) is developed which correlates the applicable PIs resulting from the ACE/AACE team's profile with the engineering team's maintenance determination. The aircraft are ranked by PI on the TSS and the point at which maintenance changes from field to depot identifies the audit threshold PI. Table 4-2 illustrates this distinct point. These audits should be conducted within thirty (30) days after the ACE/AACE team has profiled the aircraft in order to maintain a valid PI. Upon comparison of the audit and the general trend cut-off point of the PI distribution, a threshold PI can be set which accurately depicts the aircraft most in need of PDM.

Table 4-2 Threshold Survey Summary Threshold  
PI Determination (UH-1 Example)

Aircraft Serial Number	P.I.	Maint. Level	Aircraft Location
69-15345	192	F	USAREUR
66-16103	197	F	USAREUR
68-16203	210	F	USAREUR
74-22453	213*	F	Ft. Campbell
69-15543	216	D	USAREUR
71-20123	216	D	Korea
71-20041	237	D	Hawaii, 25th
73-22072	237	D	Korea
66-16599	238	D	Hawaii, 25th
*The Audit Threshold PI F - Field Maintenance D - Depot Maintenance			

#### Aircraft Threshold PI Cost Considerations

With the current engineering threshold criteria being based primarily on economic and depot requirements, experienced ACE/AACE engineering personnel are able to provide general cost estimates for the depot induction of an aircraft in the ACE/AACE program and ascertain if maintenance expenditure limits are in danger of being exceeded in accordance with TB 43-0002-3. No direct correlation has yet been established between depot induction cost and aircraft PI but efforts are ongoing to develop such a correlation.

The major costs impacting the ACE/AACE program consist of the following:

- (1) Transportation - The costs involved in moving an aircraft to and from the depot (for example, from Frankfurt, Germany to the Corpus Christi Army Depot). If aircraft is unflyable, transport aircraft are used (usually the C-5A or C-141).

- (2) Overhaul/Repair - The costs involved in performing the needed maintenance (for example, manhours, material, facilities, level of expertise, and processes).
- (3) Acquisition - The current cost of acquiring a new aircraft. If cost of repair/overhaul exceeds sixty five percent (65%) of the current acquisition cost, then aircraft disposition is recommended.

## **APPENDIX A**

### **ARMY AIRCRAFT LOGBOOK LIST**

This appendix contains a listing of various forms used within Army aviation having information and data appropriate for use in the planning and analysis of the ACE/AACE program; specifically, in the selection of indicators. This appendix is also included in Part III - Profiling.

### Army Aircraft Logbook Forms

Form number	Title	Use	Disposition
DA Form 2408	Equipment Log Assembly (Records)	Gives a reference to symbols used in logbook.	Remains in front of logbook.
DA Form 2405-4	Weapon Record Data	To provide a continuous record of firings and component replacements on armament system and subsystem(s). Maintained in the aircraft logbook on which the armament is mounted.	Form attached to weapon when evacuated or stored. Form destroyed and new one initiated upon overhaul or rebuild of weapon. Form filed, data transferred to new form. Filled form retained 90 days or until new form is filled, whichever occurs first, then destroyed.
DA Form 2408-5	Equipment Modification Record	To record data about modification on assemblies or components.	In logbook for equipment on which assembly is installed. Accompanies assembly when it is removed and placed on another end item.
DA Form 2408-9	Equipment Control Record	To provide initial basic equipment acceptance and identification information. Also provides means for updating information on ownership, location, usage, transfers, gains, losses, overhaul and rebuild, and disposition.	Disposition varies in accordance with form use. Instructions contained in TM 38-750 and TM 38-760-1.
DA Form 2408-12	Army Aviator's Flight Record	To record aircraft time and mission, and to record duty and type of flight performed by the aviator and crew.	Sent to the operations office at the end of each day. Destroyed after 3 months.
DA Form 2408-13	Aircraft Inspection and Maintenance Record	To record aircraft faults and action taken to correct them; to show flying hours, maintenance performed, and when inspections become due.	Sent at the end of each day to the aircraft maintenance office of the activity maintaining the aircraft. Destroyed after 6 months.
DA Form 2408-14	Uncorrected Fault Record	To list uncorrected faults on aircraft, including overdue replacement of components.	Destroyed 6 months after date of last entry.
DA Form 2408-15	Historical Record for Aircraft	To record historical data about an aircraft.	Permanent record in logbook; accompanies aircraft on transfer.
DA Form 2408-16	Aircraft Component Historical Record	To record historical data about aircraft components.	Permanent record in aircraft logbook; accompanies component on transfer.
DA Form 2408-17	Aircraft Inventory Record	Lists all property assigned to an aircraft, used to record periodic inventories of property.	A permanent part of the aircraft logbook.
DA Form 2408-18	Equipment Inspection List	To record most inspections on aircraft and components; provides record of component replacement.	Permanent record in logbook; accompanies aircraft on transfer.
DA Form 2408-19	Aircraft Engine Turbine Wheel Historical Record	To determine whether the turbine wheel can be overhauled or not and which of its parts should be replaced.	Retained with the turbine wheel throughout its service life.

## **APPENDIX B**

### **AIRCRAFT AUDIT WORKSHEETS**

This appendix contains the worksheets used by the ACE/AACE engineers during the sample aircraft audit performed to assist in setting the engineering threshold.

### Example

ENGINEERING EVALUATION OH-58A/C THRESHOLD RE-EVALUATION		
DATE: _____	A/C SERIAL NO: _____	
LOCATION: _____	DATE LAST ACE: _____	
<u>CORROSION</u>	<u>TOTAL</u>	
1. _____	_____	estimate of hours (ref TB 43-0002-3 dtd 18 Dec 80), subject: Maintenance (OH-58A-800 M/Hrs, OH-58C-1000 M/Hrs) expenditure limits for Army aircraft.
2.* _____	_____	maintenance allocation chart * if depot mark M/Hrs to repair, aero severity and item.
_____	_____	_____
_____	_____	_____
3.** _____	_____	item requires depot _____
_____	_____	item requires depot _____
_____	_____	item requires depot _____
_____	_____	item requires depot _____
_____	_____	item requires depot _____
_____	_____	item requires depot _____
<p>** Fill in item needing depot maintenance. Then depot requirement (i.e., tools, facilities equipment, expertise and processes).</p> <p>Recommendation:        D            F</p> <p>(circle one)</p> <p>D-for depot overhaul</p> <p>F-for field repair</p>		
<p>Profile Index No. _____</p>		
<p>_____ Engineering Evaluator AVSCOM Aircraft Engineering Assessment Team</p>		

DATE \_\_\_\_\_ LOCATION \_\_\_\_\_

=====

AIRCRAFT TYPE \_\_\_\_\_

=====

AIRCRAFT S/N \_\_\_\_\_

P.I. NO. \_\_\_\_\_

ESTIMATED M/Hs  
REQUIRED

PHASE NO. \_\_\_\_\_ PHASE DUE \_\_\_\_\_  
AIRCRAFT TIME \_\_\_\_\_  
TIME REMAINING \_\_\_\_\_

MWDs REQUIRED

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_

TBO ITEMS

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_

TOTAL M/Hs \_\_\_\_\_

# THRESHOLD ANALYSIS

## WORK SHEET

MODEL \_\_\_\_\_ LOCATION \_\_\_\_\_  
 AIRCRAFT SERIAL NO. \_\_\_\_\_ UNIT \_\_\_\_\_  
 ACE/AACE DATE \_\_\_\_\_ P.I.# \_\_\_\_\_ DATE \_\_\_\_\_

	Man/Hours Corrosion/Total	
1. Man/hour Encklog		
a. AVUM Aircraft Repair	_____	_____
b. AVIM Aircraft Repair	_____	_____
c. Depot Aircraft Repair	_____	_____
d. Modification Work Order Incorporation	_____	_____
e. Phase Maintenance Inspection	_____	_____
f. Paint	_____	_____
2. Maintenance Allocation Chart (MAC) Items		
a. AVUM Aircraft Replace	_____	_____
b. AVIM Aircraft Replace	_____	_____
c. Depot Aircraft Replace	_____	_____
3. Aircraft Requires the Following for Repair or Replace		
a. Depot Tools	_____	_____
b. Depot Facilities	_____	_____
c. Depot Equipment	_____	_____
d. Depot Expertise	_____	_____
e. Depot Processes	_____	_____
f. Depot Engineering	_____	_____
4. Shipping		
a. Flight Hrs to Depot	_____	_____
b. Man/hours for Preparation	_____	_____
c. Replacement Impact	_____	_____
5. Observations		

ENGINEERING EVALUATOR \_\_\_\_\_  
 (OCN)(ACE)(AACE)

NOTE: Repair and Repairables

	MAN-HOURS	
	CORROSION /	TOTAL
1. <u>Structures:</u>		
a. Tail number portion (hard points, sheet metal, panels).	_____	_____
b. Structure accessories (tailboom, pylon wings, stabilizers, etc.).	_____	_____
c. Doors, cowlings, skids, or landing gear and tires.	_____	_____
d. Transparencies.	_____	_____
2. <u>Electrical:</u>		
a. Wire bundles (insulating heating and deterioration).	_____	_____
b. Connectors, racks, terminals (corrosion).	_____	_____
c. Avionics (malfunction).	_____	_____
d. Electro-mechanical components (malfunction, corrosion).	_____	_____
3. <u>Hydraulics:</u>		
a. Components (corrosion).	_____	_____
b. Lines and tubing (defective and leaks).	_____	_____
c. Systems (contaminated).	_____	_____
4. <u>Flight Controls:</u>		
a. Main or Fwd Rotor -	_____	_____
(1) in fuselage (wear/corrosion).	_____	_____
(2) exterior (corrosion/wear).	_____	_____
b. Tail or Aft Rotor -	_____	_____
(1) in fuselage (wear).	_____	_____
(2) in tail boom (wear).	_____	_____
(3) exterior (corrosion).	_____	_____
5. <u>Fuel:</u>		
a. Lines and tubing (defective and leaking).	_____	_____
b. System (contamination or mal-function).	_____	_____
c. Fuel cells (leaking and deterioration).	_____	_____

	Man-Hours	Corrosion/Total
<b>6. <u>Powertrain:</u></b>		
a. Rotor head and blades or propellers (corrosion, separation)	_____	_____
b. Main transmission and mast (time, defects).	_____	_____
c. Short shaft, tail rotor drive shaft or shafting and hangar brackets.	_____	_____
d. 42 Degree and 90 Degree Gear Boxes, OR Foward and Apt, Engine and Combiner transmissions (time, defects).	_____	_____
e. Alignment (unusual wear, buckling).	_____	_____
<b>7. <u>Armament and Furnishings:</u></b>		
a. Interior (soundproofing blankets, seats).	_____	_____
b. Mechanical and electrical interfaces.	_____	_____
c. Alignment (unusual wear).	_____	_____
<b>8. <u>Engine: (Single or Right and Left)</u></b>		
a. Time (replace).	_____	_____
b. Performance (reduce power, heating, etc.).	_____	_____
c. Corrosion (exterior).	_____	_____
d. Mounts (structural defects).	_____	_____
<b>9. <u>Paint:</u></b>		
a. Paint coverage complete. Few cracks on paint or river heads-----GOOD. (Touch up).	_____	_____
b. General cracking of paint on river heads. Most river heads still covered. Flat surfaces nearly completely covered-----FAIR. (Touch up).	_____	_____
c. Most river heads partly bare. Some chipping of paint on approximately 1/3 of exterior surface. Paint checkered on flat surfaces on 1/3 of exterior-----POOR. (Strip/Repaint).	_____	_____
d. More than 1/3 of exterior exhibits chipping of paint. Most rivet heads bare. Paint oxidized with a whitish coat to it. Extensive cracking-----DETERIORATED. (Strip/Repaint).	_____	_____
<b>10. <u>Instruments:</u></b>		
a. Component (Malfunction)	_____	_____
b. Panel	_____	_____
c. Interior Lights	_____	_____

## **APPENDIX C**

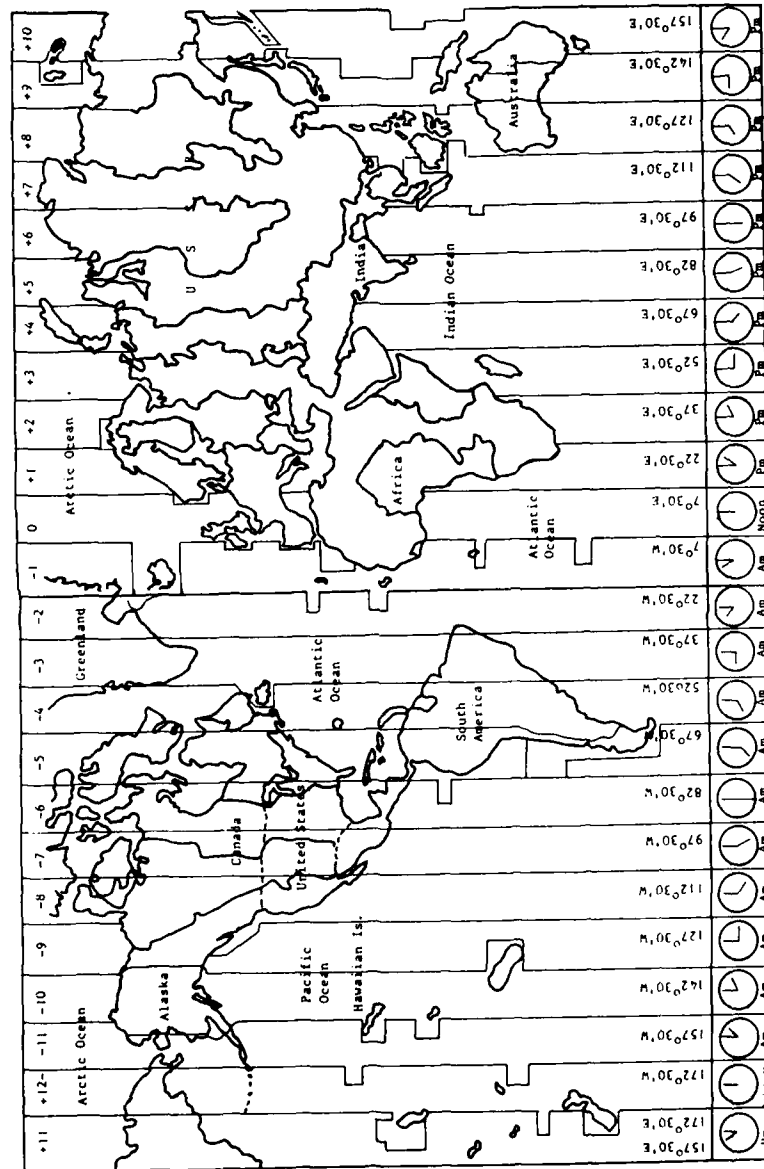
### **WORLD TRAVELER DATA**

This appendix contains selected data to assist in the travel required for ACE/AACE. This appendix is also included in Part III - Profiling.

Included are:

- World Time Zone Map
- World Monetary Systems List
- Unit Conversion Tables
- World Army Aircraft Deployment Matrix

# World Time Zones



# Monetary Systems

COUNTRY	MONETARY UNIT	COUNTRY	MONETARY UNIT
Afghanistan	Afghani	Laos	New Kip
Albania	Lek	Lebanon	Pound
Algeria	Dinar	Lesotho	Loti
Argentina	New Peso	Liberia	Dollar
Australia	Dollar	Libya	Dinar
Austria	Schilling	Liechtenstein	Franc
Bahamas	Dollar	Luxembourg	Franc
Bahrain	Dinar	Madagascar	Franc
Bangladesh	Taka	Malawi	Kwacha
Barbados	Dollar	Malaysia	Ringgit
Belgium	Franc	Maldives	Rupee
Belize	Dollar	Mali	Franc
Benin	CFA Franc	Malta	Pound
Bermuda	Dollar	Mauritania	Ouguiya
Bolivia	Peso	Mauritius	Rupee
Botswana	Pula	Mexico	Peso
Brazil	Cruzeiro	Monaco	Franc
Bulgaria	Lev	Mongolia	Tugrik
Burma	Kyat	Morocco	Dirham
Burundi	Franc	Mozambique	Metical
Cameroon	CFA Franc	Nepal	Rupee
Canada	Dollar	Netherlands	Guilder
Central African Rep.	CFA Franc	New Zealand	Dollar
Chad	CFA Franc	Nicaragua	Cordoba
Chile	Peso	Niger	CFA Franc
China	Yuan	Nigeria	Naira
Colombia	Peso	Norway	Krone
Congo	CFA Franc	Osan	Rial
Costa Rica	Colon	Pakistan	Rupee
Cuba	Peso	Panama	Balboa
Cyprus	Pound	Paraguay	Guarani
Czechoslovakia	Koruna	Peru	Sol
Denmark	Krone	Philippines	Peso
Dominican Rep.	Peso	Poland	Zloty
Ecuador	Sucre	Portugal	Escudo
Egypt	Pound	Qatar	Riyal
El Salvador	Colon	Rumania	Leu
Equat. Guinea	Ekuele	Rwanda	Franc
Ethiopia	Birr	Saudi Arabia	Riyal
Fiji	Dollar	Senegal	CFA Franc
Finland	Markka	Sierra Leone	Leone
France	Franc	Singapore	Dollar
Gabon	CFA Franc	Somalia	Shilling
Gambia	Dalasi	South Africa	Rand
Germany, East	D-Mark	Spain	Peseta
Germany, West	D-Mark	Sri Lanka	Rupee
Ghana	Cedi	Sudan	Pound
Greece	Drachma	Swaziland	Lilangeni
Grenada	Dollar	Sweden	Krona
Guatemala	Quetzal	Switzerland	Franc
Guinea	Sylli	Syria	Pound
Guinea-Bissau	Escudo	Taiwan	Dollar
Guyana	Dollar	Tanzania	Shilling
Haiti	Gourde	Thailand	Baht
Honduras	Lempira	Togo	CFA Franc
Hong Kong	Dollar	Trinidad and Tobago	Dollar
Hungary	Forint	Tunisia	Diner
Iceland	Krona	Turkey	Lira
India	Rupee	Uganda	Shilling
Indonesia	Rupiah	United Arab Emirates	Dirham
Iran	Rial	United Kingdom	Pound
Iraq	Dinar	United States	Dollar
Ireland	Pound	Upper Volta	CFA Franc
Israel	Shekel	Uruguay	Peso
Italy	Lira	USSR	Ruble
Ivory Coast	CFA Franc	Venezuela	Bolivar
Jamaica	Dollar	Vietnam	Dong
Japan	Yen	Western Samoa	Tala
Jordan	Dinar	Yemen	Dinar
Kampuchea	Riel	Yemen, Dem.	Dinar
Kenya	Shilling	Yugoslavia	Dinar
Korea, North	Won	Zaire	Zaire
Korea, South	Won	Zambia	Kwacha
Kuwait	Dinar	Zimbabwe	Dollar

# Standard Conversion Tables

## U.S. English Units to SI Units

TO CONVERT FROM	TO	MULTIPLY BY
(Acceleration) foot/second <sup>2</sup> (ft/s <sup>2</sup> ) inch/second <sup>2</sup> (in/s <sup>2</sup> )	meter/second <sup>2</sup> (m/s <sup>2</sup> ) meter/second <sup>2</sup> (m/s <sup>2</sup> )	$3.048 \times 10^{-1}$ $2.54 \times 10^{-2}$
(Area) foot <sup>2</sup> (ft <sup>2</sup> ) inch <sup>2</sup> (in <sup>2</sup> ) yard <sup>2</sup> (yd <sup>2</sup> )	meter <sup>2</sup> (m <sup>2</sup> ) meter <sup>2</sup> (m <sup>2</sup> ) meter <sup>2</sup> (m <sup>2</sup> )	$9.2903 \times 10^{-2}$ $6.4516 \times 10^{-4}$ $8.3613 \times 10^{-1}$
(Density) pound mass/inch <sup>3</sup> (lbm/in <sup>3</sup> ) pound mass/foot <sup>3</sup> (lbm/ft <sup>3</sup> )	kilogram/meter <sup>3</sup> (kg/m <sup>3</sup> ) kilogram/meter <sup>3</sup> (kg/m <sup>3</sup> )	$2.7680 \times 10^6$ $1.6018 \times 10$
(Energy, Work) British thermal unit (Btu) foot-pound force (ft · lbf) kilowatt-hour (kw · h)	joule (J) joule (J) joule (J)	$1.0544 \times 10^3$ 1.3556 $3.60 \times 10^6$
(Force) kip (1000 lbf) pound force (lbf) ounce force	newton (N) newton (N) newton (N)	$4.4482 \times 10^3$ 4.4482 $2.7801 \times 10^{-1}$
(Length) foot (ft) inch (in) mile (mi), (U.S. statute) mile (mi), (international nautical) yard (yd)	meter (m) meter (m) meter (m) meter (m) meter (m)	$3.048 \times 10^{-1}$ $2.54 \times 10^{-2}$ $1.6093 \times 10^3$ $1.852 \times 10^3$ $9.144 \times 10^{-1}$
(Mass) pound mass (lbm) slug (lb · s <sup>2</sup> /ft) ton (2000 lbm)	kilogram (kg) kilogram (kg) kilogram (kg)	$4.5359 \times 10^{-1}$ $1.4544 \times 10$ $9.0718 \times 10^3$
(Power) foot-pound/minute (ft · lbf/min) horsepower (550 ft · lbf/s)	watt (W) watt (W)	$2.2597 \times 10^{-2}$ $7.4570 \times 10^2$
(Pressure, stress) atmosphere (std) (14.7 lbf/in. <sup>2</sup> ) pound/foot <sup>2</sup> (lbf/ft <sup>2</sup> ) pound/inch <sup>2</sup> (lbf/in. <sup>2</sup> or psi)	newton/meter <sup>2</sup> (N/m <sup>2</sup> or Pa) newton/meter <sup>2</sup> (N/m <sup>2</sup> or Pa) newton/meter <sup>2</sup> (N/m <sup>2</sup> or Pa)	$1.0133 \times 10^5$ $4.7880 \times 10$ $6.8948 \times 10^3$
(Velocity) foot/minute (ft/min) foot/second (ft/s) knot (nautical mi/h) mile/hour (mi/h) mile/hour (mi/h) mile/second (mi/s)	meter/second (m/s) meter/second (m/s) meter/second (m/s) meter/second (m/s) kilometer/hour (km/h) kilometer/second (km/s)	$5.08 \times 10^{-2}$ $3.048 \times 10^{-1}$ $5.1444 \times 10^{-1}$ $4.4704 \times 10^{-1}$ 1.6093 1.6093
(Viscosity) foot <sup>2</sup> /second (ft <sup>2</sup> /s) pound-mass/foot-second (lb <sub>m</sub> /ft · s) pound-force-second/foot <sup>2</sup> (lbf · s/ft <sup>2</sup> )	meter <sup>2</sup> /second (m <sup>2</sup> /s) pascal-second (Pa · s) pascal-second (Pa · s)	$9.2903 \times 10^{-2}$ 1.4882 $4.788 \times 10$

\* Exact value

UNITS OF TEMPERATURE		
TO CONVERT FROM	TO	MULTIPLY BY
(Fahrenheit)	$^{\circ}\text{F} = (9/5) ^{\circ}\text{C} + 32$	
(Celsius)	$^{\circ}\text{C} = (5/9) (^{\circ}\text{F} - 32)$	
(Kelvin)	$^{\circ}\text{K} = ^{\circ}\text{C} + 273.16$	
(Rankine)	$^{\circ}\text{R} = ^{\circ}\text{F} + 459.69$	

UNITS OF TORQUE		
lb. in.	gram cm.	1152.128
lb. ft.	gram cm.	13.826
lb. ft.	kp meter	0.1383
oz. in.	gram cm.	72.008
oz. in.	lb. ft.	0.005208

FRACTION AND DECIMAL EQUIVALENTS			
$\frac{1}{64}$ .015625	$\frac{17}{64}$ .265625	$\frac{33}{64}$ .515625	$\frac{49}{64}$ .765625
$\frac{1}{32}$ .03125	$\frac{9}{32}$ .28125	$\frac{17}{32}$ .53125	$\frac{25}{32}$ .78125
$\frac{3}{64}$ .046875	$\frac{19}{64}$ .296875	$\frac{35}{64}$ .546875	$\frac{51}{64}$ .796875
$\frac{1}{16}$ .0625	$\frac{5}{16}$ .3125	$\frac{9}{16}$ .5625	$\frac{13}{16}$ .8125
$\frac{5}{64}$ .078125	$\frac{21}{64}$ .328125	$\frac{37}{64}$ .578125	$\frac{53}{64}$ .828125
$\frac{3}{32}$ .09375	$\frac{11}{32}$ .34375	$\frac{19}{32}$ .59375	$\frac{27}{32}$ .84375
$\frac{7}{64}$ .109375	$\frac{23}{64}$ .359375	$\frac{39}{64}$ .609375	$\frac{55}{64}$ .859375
$\frac{1}{8}$ .125	$\frac{3}{8}$ .375	$\frac{5}{8}$ .625	$\frac{7}{8}$ .875
$\frac{9}{64}$ .140625	$\frac{25}{64}$ .390625	$\frac{41}{64}$ .640625	$\frac{57}{64}$ .890625
$\frac{5}{32}$ .15625	$\frac{13}{32}$ .40625	$\frac{21}{32}$ .65625	$\frac{29}{32}$ .90625
$\frac{11}{64}$ .171875	$\frac{27}{64}$ .421875	$\frac{43}{64}$ .671875	$\frac{59}{64}$ .921875
$\frac{3}{16}$ .1875	$\frac{7}{16}$ .4375	$\frac{11}{16}$ .6875	$\frac{15}{16}$ .9375
$\frac{13}{64}$ .203125	$\frac{29}{64}$ .453125	$\frac{45}{64}$ .703125	$\frac{61}{64}$ .953125
$\frac{7}{32}$ .21875	$\frac{15}{32}$ .46875	$\frac{23}{32}$ .71875	$\frac{31}{32}$ .96875
$\frac{15}{64}$ .234375	$\frac{31}{64}$ .484375	$\frac{47}{64}$ .734375	$\frac{63}{64}$ .984375
$\frac{1}{4}$ .25	$\frac{1}{2}$ .5	$\frac{3}{4}$ .75	1

## SI Units and Symbols

BASE UNITS			
QUANTITY	UNIT	SI SYMBOL	FORMULA
length	meter	m	...
mass	kilogram	kg	...
time	second	s	...
electric current	ampere	A	...
thermodynamic temperature	kelvin	K	...
amount of substance	mole	mol	...
luminous intensity	candela	cd	...
SUPPLEMENTARY UNITS:			
plane angle	radian	rad	...
solid angle	steradian	sr	...
DERIVED UNITS:			
acceleration	meter per second squared	...	$m/s^2$
angular acceleration	radian per second squared	...	$rad/s^2$
angular velocity	radian per second	...	$rad/s$
area	square meter	...	$m^2$
density	kilogram per cubic meter	...	$kg/m^3$
electric potential difference	volt	V	$W/A$
electric resistance	ohm	$\Omega$	$V/A$
energy	joule	J	$N \cdot m$
entropy	joule per kelvin	...	$J/K$
force	newton	N	$kg \cdot m/s^2$
frequency	hertz	Hz	$1/s$
magnetomotive force	ampere	A	...
power	watt	W	$J/s$
pressure	pascal	Pa	$N/m^2$
quantity of electricity	coulomb	C	$A \cdot s$
quantity of heat	joule	J	$N \cdot m$
radiant intensity	watt per steradian	...	$W/sr$
specific heat	joule per kilogram-kelvin	...	$J/kg \cdot K$
stress	pascal	Pa	$N/m^2$
thermal conductivity	watt per meter-kelvin	...	$W/m \cdot K$
velocity	meter per second	...	$m/s$
viscosity, dynamic	pascal-second	...	$Pa \cdot s$
viscosity, kinematic	square meter per second	...	$m^2/s$
volume	cubic meter	...	$m^3$
work	joule	J	$N \cdot m$
SI PREFIXES			
MULTIPLICATION FACTORS	PREFIX	SI SYMBOL	
1 000 000 000 000 = $10^{12}$	tera	T	
1 000 000 000 = $10^9$	giga	G	
1 000 000 = $10^6$	mega	M	
1 000 = $10^3$	kilo	k	
100 = $10^2$	hecto	h	
10 = $10^1$	deka	da	
0.1 = $10^{-1}$	deci	d	
0.01 = $10^{-2}$	centi	c	
0.001 = $10^{-3}$	milli	m	
0.000 001 = $10^{-6}$	micro	$\mu$	
0.000 000 001 = $10^{-9}$	nano	n	
0.000 000 000 001 = $10^{-12}$	pico	p	
0.000 000 000 000 001 = $10^{-15}$	femto	f	
0.000 000 000 000 000 001 = $10^{-18}$	atto	a	

[illegible]

Location	Aircraft	AH-15	AH-66A	CH-47A	CH-47B	CH-47C	CH-47D	CN-54A	CN-54B	OH-58A	OH-58B	OH-58C	OH-6A	OV-6A	OV-1C	OV-1D	RV-1D	U-21A	U-21F	U-21C	RU-21A	RU-21B	RU-21C	KU-21H	UH-1B	UH-1C	UH-1H	UH-1H	UH-1V	UH-60A	Total	
CONNECTICUT																																
Graton/New London Airport																																
Bradley Intl. Airport									10																		26		2			2
DELAWARE																																
Greater Wilmington Airport														3													26					29
FLORIDA																																
Craig Field Municipal Airport	2	13											23					1		11		2					29	6			74	
Orlando Jetport																											6				17	
McDill AFB																											4				6	
Opelouska Airport																											1		5		6	
GEORGIA																																
Bush Field																												2			3	
Winder-Barrow													3			14												4			14	
Dobbins AFB																14															21	
Charlie Brown Airport																		4									4				8	
Hunter AAF & Ft. Stewart	30	16					10						40		12			10									31			16	165	
Lowson AAF Ft. Benning								8									1									15			26	6	56	
HAWAII																																
Manali																												70	6		237	
Manali							16			60								1														
IDAHO																																
Boise Muni Airport										14								1										18	12		45	
ILLINOIS																																
Decatur Airport									10																			14			24	
Midway Airport								8																				16			24	
Glenview NAS																												34			38	
Glenview NAS																												3			4	
Glenview NAS																		1														
Scott AFB																												26			26	8
Parks Bt-State Airport																												6				
INDIANA																																
Shelby Co. Airport										32																		17			49	
Indianapolis Intl. Airport																			1								2				3	
IOWA																																
Davenport Muni Airport																												21			21	
Waterloo Muni Airport																												7	8		25	

# Army Aircraft Deployment (Cont'd)

Location	Aircraft	A/TN-1C	AM-15	CH-47A	CH-47B	CH-47C	CH-47D	CH-54A	CH-54B	OH-58A	OH-58B	OH-58C	OH-6A	OV-6A	OV-1C	OV-1D	RV-1D	U-21A	U-21F	U-21C	RU-21A	RU-21B	RU-21C	RU-21H	UH-1B	UH-1C	UH-1H	UH-1M	UH-1V	UH-60A	Total
<b>LOUISIANA</b>																															
Boone Airport										4																					25
Des Moines Muni Airport										4																					9
Marshall AAF										37																					124
Industrial Airport																															14
Forbes AFB										6																					25
<b>KENTUCKY</b>																															
Capital City Airport										6																					39
Goodman AAF										6																					22
Campbell AAF										30																					456
Bowman Field																															7
<b>LOUISIANA</b>																															
Lakefront Airport										12																					31
Acadiana Regional Airport																															11
Polk AAF										20																					60
<b>MAINE</b>																															
Bangor Intl. Airport										3																					32
<b>MARYLAND</b>																															
Phillips AAF																															6
Meade AAF																															51
Tipton AAF																															39
Wagertown Muni Airport										15																					10
<b>MASSACHUSETTS</b>																															
Revere AAF										13																					34
Otis AFB																															36
Westover AFB																															5
<b>MICHIGAN</b>																															
Abrams Muni Airport										18																					62
Spartan AFB																															5
Oakland Pontiac Airport																															1
<b>MINNESOTA</b>																															
Downtown Airport										24																					37
Downtown Airport										11																					23

## Army Aircraft Deployment (Cont'd)

Location	Aircraft	AR-15	CH-47A	CH-47B	CH-47C	CH-54A	CH-54B	OH-58A	OH-58B	OH-58C	OH-6A	OV-10A	OV-10B	OV-10C	OV-10D	OV-10E	OV-10F	OV-10G	OV-10H	OV-10I	OV-10J	OV-10K	OV-10L	OV-10M	OV-10N	OV-10O	OV-10P	OV-10Q	OV-10R	OV-10S	OV-10T	OV-10U	OV-10V	OV-10W	OV-10X	OV-10Y	OV-10Z	OV-10AA	OV-10AB	OV-10AC	OV-10AD	OV-10AE	OV-10AF	OV-10AG	OV-10AH	OV-10AI	OV-10AJ	OV-10AK	OV-10AL	OV-10AM	OV-10AN	OV-10AO	OV-10AP	OV-10AQ	OV-10AR	OV-10AS	OV-10AT	OV-10AU	OV-10AV	OV-10AW	OV-10AX	OV-10AY	OV-10AZ	OV-10BA	OV-10BB	OV-10BC	OV-10BD	OV-10BE	OV-10BF	OV-10BG	OV-10BH	OV-10BI	OV-10BJ	OV-10BK	OV-10BL	OV-10BM	OV-10BN	OV-10BO	OV-10BP	OV-10BQ	OV-10BR	OV-10BS	OV-10BT	OV-10BU	OV-10BV	OV-10BW	OV-10BX	OV-10BY	OV-10BZ	OV-10CA	OV-10CB	OV-10CC	OV-10CD	OV-10CE	OV-10CF	OV-10CG	OV-10CH	OV-10CI	OV-10CJ	OV-10CK	OV-10CL	OV-10CM	OV-10CN	OV-10CO	OV-10CP	OV-10CQ	OV-10CR	OV-10CS	OV-10CT	OV-10CU	OV-10CV	OV-10CW	OV-10CX	OV-10CY	OV-10CZ	OV-10DA	OV-10DB	OV-10DC	OV-10DD	OV-10DE	OV-10DF	OV-10DG	OV-10DH	OV-10DI	OV-10DJ	OV-10DK	OV-10DL	OV-10DM	OV-10DN	OV-10DO	OV-10DP	OV-10DQ	OV-10DR	OV-10DS	OV-10DT	OV-10DU	OV-10DV	OV-10DW	OV-10DX	OV-10DY	OV-10DZ	OV-10EA	OV-10EB	OV-10EC	OV-10ED	OV-10EE	OV-10EF	OV-10EG	OV-10EH	OV-10EI	OV-10EJ	OV-10EK	OV-10EL	OV-10EM	OV-10EN	OV-10EO	OV-10EP	OV-10EQ	OV-10ER	OV-10ES	OV-10ET	OV-10EU	OV-10EV	OV-10EW	OV-10EX	OV-10EY	OV-10EZ	OV-10FA	OV-10FB	OV-10FC	OV-10FD	OV-10FE	OV-10FF	OV-10FG	OV-10FH	OV-10FI	OV-10FJ	OV-10FK	OV-10FL	OV-10FM	OV-10FN	OV-10FO	OV-10FP	OV-10FQ	OV-10FR	OV-10FS	OV-10FT	OV-10FU	OV-10FV	OV-10FW	OV-10FX	OV-10FY	OV-10FZ	OV-10GA	OV-10GB	OV-10GC	OV-10GD	OV-10GE	OV-10GF	OV-10GG	OV-10GH	OV-10GI	OV-10GJ	OV-10GK	OV-10GL	OV-10GM	OV-10GN	OV-10GO	OV-10GP	OV-10GQ	OV-10GR	OV-10GS	OV-10GT	OV-10GU	OV-10GV	OV-10GW	OV-10GX	OV-10GY	OV-10GZ	OV-10HA	OV-10HB	OV-10HC	OV-10HD	OV-10HE	OV-10HF	OV-10HG	OV-10HH	OV-10HI	OV-10HJ	OV-10HK	OV-10HL	OV-10HM	OV-10HN	OV-10HO	OV-10HP	OV-10HQ	OV-10HR	OV-10HS	OV-10HT	OV-10HU	OV-10HV	OV-10HW	OV-10HX	OV-10HY	OV-10HZ	OV-10IA	OV-10IB	OV-10IC	OV-10ID	OV-10IE	OV-10IF	OV-10IG	OV-10IH	OV-10II	OV-10IJ	OV-10IK	OV-10IL	OV-10IM	OV-10IN	OV-10IO	OV-10IP	OV-10IQ	OV-10IR	OV-10IS	OV-10IT	OV-10IU	OV-10IV	OV-10IW	OV-10IX	OV-10IY	OV-10IZ	OV-10JA	OV-10JB	OV-10JC	OV-10JD	OV-10JE	OV-10JF	OV-10JG	OV-10JH	OV-10JI	OV-10JJ	OV-10JK	OV-10JL	OV-10JM	OV-10JN	OV-10JO	OV-10JP	OV-10JQ	OV-10JR	OV-10JS	OV-10JT	OV-10JU	OV-10JV	OV-10JW	OV-10JX	OV-10JY	OV-10JZ	OV-10KA	OV-10KB	OV-10KC	OV-10KD	OV-10KE	OV-10KF	OV-10KG	OV-10KH	OV-10KI	OV-10KJ	OV-10KK	OV-10KL	OV-10KM	OV-10KN	OV-10KO	OV-10KP	OV-10KQ	OV-10KR	OV-10KS	OV-10KT	OV-10KU	OV-10KV	OV-10KW	OV-10KX	OV-10KY	OV-10KZ	OV-10LA	OV-10LB	OV-10LC	OV-10LD	OV-10LE	OV-10LF	OV-10LG	OV-10LH	OV-10LI	OV-10LJ	OV-10LK	OV-10LL	OV-10LM	OV-10LN	OV-10LO	OV-10LP	OV-10LQ	OV-10LR	OV-10LS	OV-10LT	OV-10LU	OV-10LV	OV-10LW	OV-10LX	OV-10LY	OV-10LZ	OV-10MA	OV-10MB	OV-10MC	OV-10MD	OV-10ME	OV-10MF	OV-10MG	OV-10MH	OV-10MI	OV-10MJ	OV-10MK	OV-10ML	OV-10MM	OV-10MN	OV-10MO	OV-10MP	OV-10MQ	OV-10MR	OV-10MS	OV-10MT	OV-10MU	OV-10MV	OV-10MW	OV-10MX	OV-10MY	OV-10MZ	OV-10NA	OV-10NB	OV-10NC	OV-10ND	OV-10NE	OV-10NF	OV-10NG	OV-10NH	OV-10NI	OV-10NJ	OV-10NK	OV-10NL	OV-10NM	OV-10NO	OV-10NP	OV-10NQ	OV-10NR	OV-10NS	OV-10NT	OV-10NU	OV-10NV	OV-10NW	OV-10NX	OV-10NY	OV-10NZ	OV-10OA	OV-10OB	OV-10OC	OV-10OD	OV-1
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# Army Aircraft Deployment (Cont'd)

Location	Aircraft	A/TH-1G	AH-1S	AR-64A	CR-47A	CR-47B	CR-47C	CR-54A	CR-54B	OH-58A	OH-58B	OH-58C	OH-6A	OV-6A	OV-1C	OV-1D	RV-1D	U-21A	U-21F	U-21G	RU-21A	RU-21B	RU-21C	RU-21H	UH-1B	UH-1C	UH-1H	UH-1H	UH-60A	Total
<b>NEW YORK CONT'D</b>																														
Long Island McArthur Airport Mgr A																														
Wheeler-Sack AAF																														
Seneca AAF																														
<b>NORTH CAROLINA</b>																														
Bowen Co. Airport										11																				
Raleigh-Durham Airport										11																				
Simons AAF										41		42							7						62				64	286
<b>NORTH DAKOTA</b>																														
Bismarck Muni Airport													5																	
<b>OHIO</b>																														
Lorain Co. Regional Airport																														
Akron-Canton Airport										18																				
Don Scott Field										23																				
Columbus Muni Airport										3																				
<b>OKLAHOMA</b>																														
Gen Howell Mndow Airport										10																				
Max Westheimer Airport										4																				
Berry Post AAF										20																				
Tulsa Intl Airport													24																	
<b>OREGON</b>																														
McNary Field										10							11													
<b>PENNSYLVANIA</b>																														
Washington County Airport													13																	
<b>PAIR AAF</b>										10			29																	
Chambersburg Muni Airport																														
Willow Grove BAS										6																				
<b>RHODE ISLAND</b>																														
Quonset Airport													11																	
<b>SOUTH CAROLINA</b>																														
McEntire ANGB										17																				
Columbia Metro Airport																														
<b>SOUTH DAKOTA</b>																														
Rapid City Regional Airport																														

[illegible]

### Army Aircraft Deployment (Cont'd)

[illegible]

# Army Aircraft Deployment (Cont'd)

Location	Aircraft	A/TR-1C	AM-15	AB-64A	CH-47A	CH-47B	CH-47C	CH-47D	CH-54A	CH-54B	OH-58A	OH-58B	OH-58C	OH-6A	OV-6A	OV-1C	OV-1D	RV-1D	U-21A	U-21F	U-21G	RU-21A	RU-21B	RU-21C	RU-21H	UH-1B	UH-1C	UH-1H	UH-1H	UH-1V	UH-60A	Total
<u>EUROPE CONT'D</u>																																
Fischbach			22								12	4																3				37
Fischbach																																7
Fischbach																																15
Fischbach							20																									6
Kumboldale											4																					4
Manau			1																													8
Manau											7																					8
Manau																																2
Manau																																4
Manau			20								24																					51
Manau			21								12																					34
Manau											3																					36
Manau																																5
Manau																																15
Neishaden											4																					4
Neillingen			1								5																					12
Neillingen																																6
Neillingen																																1
Schwenfurt											12																					6
Starnstedt																																6
Polda											6																					13
Polda			21																													3
Reudmer																																12
Giebelstedt											20																					36
Wertheim											16																					12
Katterbach											16																					20
Katterbach			21								17																					3
Katterbach			21								16																					3
Katterbach											5																					5
Katterbach																																10
Katterbach																																2
Katterbach																																2
Fuecht			21																													13
Fuecht											4																					13
Grafenmoehr																																6
Grafenmoehr																																4

# Army Aircraft Deployment (Cont'd)

Location	Aircraft	A/TH-1G	AH-1S	AH-64A	CH-47A	CH-47B	CH-47C	CH-47D	CH-54A	CH-54B	OH-58A	OH-58B	OH-58C	OH-6A	OV-6A	OV-1C	OV-1D	KV-1D	U-21A	U-21F	U-21G	RU-21A	RU-21B	RU-21C	KU-21H	UH-1B	UH-1C	UH-1H	UH-1M	UH-1V	UH-60A	Total
EUROPE CONT'D																																
Bremen											4																					7
Bremen																																6
Bad Tölz																																2
Echternngen																																20
Echternngen											20																					5
Echternngen																			1													26
Echternngen																	26															21
Schweibisch Hall								20											1													4
Schweibisch Hall																																2
Coppingen																																6
Schweibisch, Gmund																																15
Augsburg																																7
Augsburg																																3